AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A multi-layer insulation blanket ~~attachable to~~providing thermal protection to a spacecraft portion~~, said multi-layer insulation blanket~~ comprising:

a portion of the spacecraft on which thermal protection is desirable; and

a multi-layer insulation blanket attachable on the portion of the spacecraft to provide thermal protection to the portion of the spacecraft, said multi-layer insulation blanket including:

an outer sheet of thermally insulative plastic material, said outer sheet having a reflective surface on a side of said outer sheet of thermally insulative plastic material facing space when said multi-layer insulation blanket is attached to the spacecraft;

at least one inner sheet of thermally insulative plastic material between said outer sheet of thermally insulative plastic material and the spacecraft when said multi-layer insulation blanket is attached to the spacecraft; and

a coating of anti-contaminant material overlying said reflective surface of said outer sheet of thermally insulative plastic material, said coating of anti-contaminant material being effective to induce the breakdown of organic residues on said outer surface of said outer sheet of thermally insulative plastic material in the presence of solar radiation, said coating of anti-contaminant material having a thickness no greater than 200 nanometers.

2. (Original) The multi-layer insulation blanket of Claim 1 wherein said outer sheet of thermally insulative plastic material comprises metallized polyimide material or metallized polyester material.

3. (Original) The multi-layer insulation blanket of Claim 1 wherein said at least one inner sheet of thermally insulative plastic material comprises polyimide material or polyester material.

4. (Original) The multi-layer insulation blanket of Claim 1 wherein said at least one inner sheet of thermally insulative plastic material is metallized.

5. (Original) The multi-layer insulation blanket of Claim 1 wherein said outer sheet of thermally insulative plastic material and said at least one inner sheet of thermally insulative plastic material are coextensive with one another.

6. (Original) The multi-layer insulation blanket of Claim 1 wherein said anti-contaminant material comprises a photocatalytic material.

7. (Original) The multi-layer insulation blanket of Claim 6 wherein said photocatalytic material comprises a photoactive transition metal oxide.

8. (Original) The multi-layer insulation blanket of Claim 7 wherein said photoactive transition metal oxide is selected from the group consisting of TiO_2, ZnO, WO_3, $CaTiO_3$, SnO_2, MoO_3, NbO_5, Fe_2O_3, Ta_2O_5, and $Ti_X(Zr_{1-X})O_2$, where X has a value of between 0 and 1.

9. (Original) The multi-layer insulation blanket of Claim 1 further comprising at least one layer of lightweight spacing material disposed between said outer sheet of thermally insulative plastic material and said at least one inner sheet of thermally insulative plastic material.

10. (Currently Amended) The multi-layer insulation blanket of Claim 9 wherein said lightweight spacing material comprises nylon mesh or glass fiber mesh.

11. (Original) The multi-layer insulation blanket of Claim 1 further comprising a high emittance layer between said reflective surface and said coating of anti-contaminant material.

12. (Original) The multi-layer insulation blanket of Claim 11 wherein said high emittance layer comprises a material selected from the group consisting of glass, quartz, silicon nitride, and silicon oxy-nitride.

13. (Original) The multi-layer insulation blanket of Claim 11 further comprising an

electrically conductive layer, wherein said electrically conductive layer overlies said coating of anti-contaminant material or is between said coating of anti-contaminant material and said high emittance layer.

14. (Original) The multi-layer insulation blanket of Claim 13 wherein said electrically conductive layer comprises one of indium tin oxide and indium oxide.

15. (Currently Amended) A multi-layer insulation blanket attachable on a structure intended for use in vacuum conditions, said multi-layer insulation blanket comprising:

an outer sheet of thermally insulative plastic material, said outer sheet having a reflective surface on at least a first side thereof facing away from said structure when said multi-layer insulation blanket is attached to the structure;

at least one inner sheet of thermally insulative plastic material between said outer sheet and the structure when said multi-layer insulation blanket is attached to the structure;

a high emittance layer overlying said reflective surface of said outer sheet of thermally insulative plastic material; and

a coating of photocatalytic material overlying said high emittance layer, wherein said coating of photocatalytic material catalyzes the breakdown of organic residues on said outer surface of said outer sheet of thermally insulative plastic material when exposed to at least one of ultraviolet and near-ultraviolet radiation, and wherein said coating of photocatalytic material has a thickness no greater than 200 nanometers.

16. (Original) The multi-layer insulation blanket of Claim 15 wherein said outer sheet of thermally insulative plastic material comprises metallized polyimide material or metallized polyester material.

17. (Original) The multi-layer insulation blanket of Claim 15 wherein said at least one inner sheet of thermally insulative plastic material comprises polyimide material or polyester material.

18. (Original) The multi-layer insulation blanket of Claim 15 wherein said at least one inner sheet of thermally insulative plastic material is metallized.

19. (Original) The multi-layer insulation blanket of Claim 15 wherein said outer sheet of thermally insulative plastic material and said at least one inner sheet of thermally insulative plastic material are coextensive with one another.

20. (Original) The multi-layer insulation blanket of Claim 15 wherein said photocatalytic material comprises a photoactive transition metal oxide.

21. (Original) The multi-layer insulation blanket of Claim 20 wherein said photoactive transition metal oxide is selected from the group consisting of TiO_2, ZnO, WO_3, $CaTiO_3$, SnO_2, MoO_3, NbO_5, Fe_2O_3, Ta_2O_5, and $Ti_X(Zr_{1-X})O_2$, where X has a value of between 0 and 1.

22. (Original) The multi-layer insulation blanket of Claim 15 further comprising at least one layer of lightweight spacing material disposed between said outer sheet of thermally insulative plastic material and said at least one inner sheet of thermally insulative plastic material.

23. (Original) The multi-layer insulation blanket of Claim 22 wherein said lightweight spacing material comprises nylon mesh or glass fiber mesh.

24. (Original) The multi-layer insulation blanket of Claim 15 wherein said high emittance layer comprises a material selected from the group consisting of glass, quartz, silicon nitride, and silicon oxy-nitride.

25. (Original) The multi-layer insulation blanket of Claim 15 further comprising an electrically conductive layer, wherein said electrically conductive layer overlies said coating of anti-contaminant material or is between said coating of anti-contaminant material and said high emittance

layer.

26. (Original) The multi-layer insulation blanket of Claim 25 wherein said electrically conductive layer comprises one of indium tin oxide and indium oxide.

27. (Original) The multi-layer insulation blanket of Claim 15 wherein the structure comprises a spacecraft.

28. (Withdrawn) A method for inhibiting the formation of organic residues on the outer surface of a multi-layer insulation blanket attachable on a structure intended for use in vacuum conditions, said method comprising the steps of:

coating an outer surface of an outer layer of the multi-layer insulation blanket that faces away from the structure when the multi-layer insulation blanket is attached to the structure with a photocatalytic material; and

exposing the photocatalytic material coated outer surface of the outer layer of the multi-layer insulation blanket to at least one of ultraviolet radiation and near-ultraviolet radiation to activate the photocatalytic material to catalyze the breakdown of organic residues on the outer surface of the outer layer of the multi-layer insulation blanket.

29. (Withdrawn) The method of Claim 28 wherein in said step of coating, the photocatalytic material comprises a photoactive transition metal oxide.

30. (Withdrawn) The method of Claim 29 wherein in said step of coating, the photoactive transition metal oxide is selected from the group consisting of TiO_2, ZnO, WO_3, $CaTiO_3$, SnO_2, MoO_3, NbO_5, Fe_2O_3, Ta_2O_5, and $Ti_X(Zr_{1-X})O_2$, where X has a value of between 0 and 1.

31. (Withdrawn) The method of Claim 28 wherein in said step of coating, the photocatalytic material is applied in a layer having a thickness within a range of 2 nm to 200 nm.

32. (Withdrawn) The method of Claim 28 wherein the structure comprises a spacecraft, and wherein said step of exposing comprises exposing the spacecraft to solar radiation in space.

33. (Withdrawn) The method of Claim 28 wherein in said step of coating, the photocatalytic material is coated over a high emittance layer on the outer surface of the multi-layer insulation blanket.

34. (Withdrawn) The method of Claim 28 wherein in said step of coating, the photocatalytic material is coated over an electrically conductive layer overlying a high emittance layer on the outer surface of the multi-layer insulation blanket.

REMARKS

In accordance with the Office Action, claims 1-27 stand rejected and Claims 28-34 have been withdrawn from further consideration. More particularly, the Examiner has rejected independent Claims 1 and 15 under 35 U.S.C. § 103(a) contending that such claims are obvious based on U.S. Patent No. 5,143,770 to Gonczy et al. (Gonczy) in view of published United States Patent Application No. 2003/0039848 by Murata et al. (Murata). Applicant submits that independent Claims 1 and 15 as presently presented are not obvious based on Gonczy in view of Murata and respectfully requests reconsideration and allowance of independent Claims 1 and 15 and all claims depending therefrom.

Independent Claim 1 is directed to a multi-layer insulation blanket providing thermal protection to a spacecraft portion comprising a portion of the spacecraft on which thermal protection is desirable and a multi-layer insulation blanket attachable on the portion of the spacecraft to provide thermal protection to the portion of the spacecraft. The multi-layer insulation blanket includes an outer sheet of thermally insulative material having a reflective surface on a side of the outer sheet of thermally insulative plastic material facing space when said multi-layer insulation blanket is attached to the spacecraft, at least one inner sheet of thermally insulative plastic material between the outer sheet of thermally insulative plastic material and the spacecraft when said multi-layer insulation blanket is attached to the spacecraft, and a coating of anti-contaminant material overlying the reflective surface of the outer sheet of thermally insulative plastic material, the coating of anti-contaminant material being effective to induce the breakdown of organic residues on the outer surface of the outer sheet of thermally insulative plastic material in the presence of solar radiation, and the coating of anti-contaminant material having a thickness no greater than 200 nanometers.

Independent Claim 15 is directed to a multi-layer insulation blanket attachable on a structure intended for use in vacuum conditions. The multi-layer insulation blanket comprises an outer sheet of thermally insulative plastic material having a reflective surface on at least a first side thereof facing away from the structure when said multi-layer insulation blanket is attached to the structure, at least one inner sheet of thermally insulative plastic material between the outer sheet and the structure when the multi-layer insulation blanket is attached to the structure, a high emittance layer overlying

the reflective surface of the outer sheet of thermally insulative plastic material, and a coating of photocatalytic material overlying the high emittance layer, wherein the coating of photocatalytic material catalyzes the breakdown of organic residues on the outer surface of the outer sheet of thermally insulative plastic material when exposed to at least one of ultraviolet and near-ultraviolet radiation, and wherein the coating of photocatalytic material has a thickness no greater than 200 nanometers.

Gonczy discloses a multilayer insulation blanket for insulating cryogenic structures operating at very low temperatures such as a cryosat of the Super-conducting Super Collider. (See Abstract and Col. 1, lines 14-16, FIG. 1, and Col. 5 line 28 through Col. 6, line 3). Gonczy further mentions that the multilayer insulation blanket may generally be useful in applications that require a supported structure to be insulated in a cryogenic environment subject to wide temperature fluctuations such as low temperature magnets for industrial and medical uses, dewars for storing liquified gases at low temperatures and vehicles for transporting low temperature materials. (See Col. 4, lines 54-63). Despite the various applications mentioned in Gonczy for the multilayer insulation blanket, Gonczy does not disclose use of the multilayer insulation blanket to provide thermal protection for a portion of a spacecraft.

Further, as noted by the Examiner, Gonczy does not disclose inclusion of an anti-contaminant material or a photocatalyst material on an outer layer of the multilayer insulation blanket. In fact, Gonczy provides no motivation or suggestion for including such a material because the multilayer insulation blankets 40, 41 and 42 in Gonczy are enclosed within vacuum vessel 39 of the cryosat 10 and thus would not be exposed to solar radiation/ultraviolet and near ultraviolet radiation.

Murata discloses a photocatalyst module including a substrate, a photocatalyst, and a protective layer containing lithium silicate between the substrate and the photocatalyst that prevents oxidation or decomposition of the substrate by the action of the photocatalyst. (See paragraphs [0010] and [0011]). Murata also discloses inclusion of the photocatalyst module within a photocatalyst reaction apparatus such as a water purification apparatus, an air cleaning device, a deodorizing device, a soundproofing wall of a road, a traffic sign, a cover of a lighting fixture, an outer wall or inner wall of architectures, and tile. (See paragraph [0078]). Murata

does not disclose the combination of a photocatalyst layer on a multi-layer insulation blanket and also does not disclose use of the photocatalyst module in providing thermal protection for a portion of a spacecraft or a structure intended for use in vacuum conditions.

Furthermore, the photocatalyst layer disclosed in Murata is significantly thicker than the anti-contaminant material and photocatalytic material coatings included in the multi-layer insulation blanket as recited in independent Claims 1 or 15. In this regard, Applicant's anti-contaminant material and photocatalytic material coatings are no thicker than 200 nanometers so that the coatings do not substantially interfere with the reflective properties of the reflective surface of the outer sheet. (See Patent Application pg. 7, lines 6-11). In contrast, Murata discloses that the photocatalyst layer of the photocatalyst module is preferably between about 0.3 and 0.5 millimeters (See paragraph [0076]), and there is no motivation or suggestion in Murata to make the photocatalytic layer as thin as in Applicant's invention. In this regard, since Murata does not disclose use of the photocatalyst module in thermal protection applications where reflection of solar radiation is desirable, Murata does not even recognize the need to keep the photocatalytic layer thin enough so that it does not interfere with reflective properties of the material it overlies.

Due to the noted deficiencies with the disclosures of Gonczy and Murata, one skilled in the art could not combine the teachings of Gonczy and Murata to achieve Applicant's invention claimed in independent Claims 1 and 15, nor would one skilled in the art be motivated to modify the teachings of Gonczy and Murata to achieve Applicant's invention claimed in independent Claims 1 and 15. Since independent Claims 1 and 15 are allowable, there is no need to separately address the patentability of Claims 1-14 and 16-27 depending therefrom.

Conclusion:

In view of the foregoing, allowance of all examined claims is respectfully requested. In the event that a telephone conference would further prosecution, the Examiner is invited to contact the undersigned.

Respectfully submitted,
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